SOD/M76-079
9 December 1976

MEMORANDUM FOR: Chief, Operations, OC

25X1 FROM : [redacted]
Chief, Staff Operations Division, OC-O

SUBJECT : Morse Code Requirements

REFERENCE : OC-O/M76-212

1. A survey has been conducted in response to the reference memorandum concerning an alternative to our manual Morse network and to determine what impact such a change would have upon our Panel T hiring practices. During the investigation it became apparent that an alternative system should allow for a gradual transition from manual Morse, should allow for some degree of inter-operability with other governmental services, should allow for the eventual automation of the base station NCS function to facilitate overseas personnel reductions and should allow for field to field contact in order to avoid reliance on large base stations. The system must provide for two-way alternate communications from both on and off station sites. The writer is relatively confident that these goals can be achieved with a cost effective system by utilizing microprocessor technology now being employed for similar communications requirements. An automatic Morse code system would appear to be the best alternative to meet the requirement as stated. It is recommended that a joint operations and engineering project be initiated to develop a prototype automated system. The prototype system should be based upon automated Morse code but could include other codes, e.g., FSK/baudot, for comparison purposes. Two engineering test models of the prototype system should be built and tested between [redacted] and a distant 25X1
25X1 [redacted] field station. The test should compare manual Morse against the prototype system with ability to alert the distant station as the major criteria for evaluation. The ability to pass circuit information would rank second in importance

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with message transmission as the third basic requirement. It is also recommended that the Panel T code speed requirements be immediately lowered. The information passed on our present manual Morse net could be efficiently handled at 10 words per minute or less.

2. The manual Morse code capability has served OC well. The staff Morse network has provided a reliable, last resort method of passing traffic, an order wire capability and a simple mode of communications from off-site locations. With the obvious advantages offered by the manual Morse network, why should we consider a change? First, we have changed the way we use the Morse network considerably during the past decade. Morse is almost never used to exchange traffic by necessity at present. Emergency uses from off-station sites are extremely rare. A search of the Headquarters Signal Center records disclosed no instances of Morse/OTP messages sent from off-station sites during a crisis. The on-site order wire transmissions are short and repetitive information is exchanged (See Attachment A). You could almost describe this use as a signaling system since alerting the distant station, normally field to base, is the most important feature of the system. Second, the manual Morse system is operator intensive. Base station operators must attend the NCS position for effective operations. The system's effectiveness is directly related to the operator attention allocated to monitor tasks and to the quality of the operators. The present Morse system requires regional base stations to be effective. Network changes, such as a mini-relay arrangement, will not be well served by manual Morse since field station operators cannot closely monitor for Morse calls while performing their other duties. An automated system would allow for the eventual conversion of base stations to a semi-sleeper status and for field station to field station HF alerting and signal exchanges. Finally, personnel must be hired for Panel T for their Morse code skills and/or trained for these skills. The retention of Morse skills as a basic hiring criteria limits our ability to adapt our operator cadre for changing requirements, to meet EEO responsibilities and to open Panel T positions to Agency personnel who do not possess Morse skills, e.g., Panel C personnel. (See Attachment B for present hiring statistics).

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3. An evaluation of the Morse code network cannot be completed without making some assumptions about the nature of the OC network of the future and the skills required for Panel T personnel to perform effectively in this new environment. First, OC field stations will be technically more complex. The typical field station will be equipped with a SKYLINK terminal and some quantity of backup HF equipment. The station may have an automated field terminal or, at a minimum, machines which will eliminate or reduce the poking work load, e.g., an OCR. It is likely that the field station operator will be called upon to support one or more NOC circuits and perhaps to service remote entry terminals used for data or interactive exchanges. The operator will have to be more familiar with computer usage and terminology. The network will probably utilize a protocol which provides error correction and block mode transmissions. The operator at the overseas base station will probably be primarily concerned with facilities control functions and covert communications duties. The operator in the Headquarters area will be required to operate a complex message switch, an expanded CDS system, to work in DATACOM, to master extremely complicated facilities control complexes and to live in a data rather than a narrative message world. (See Attachment C). Imposed on top of this system will be an expanded secure voice and facsimile network. Our recruitment efforts could be redirected as follows if the Morse code requirement were eliminated:

a. Operators could be hired with good technical skills. Individuals with experience as technicians in the military and people with associate degrees in technical fields offer a possible recruitment pool.

b. The military is now assigning some of their best people to technical control positions. This reservoir could be drawn upon for Panel T.

c. The Army now selects their better communicators to work in the AUTODIN network. This type background would be suitable for Panel T operators of the future.

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d. Individuals with education or experience related to computer operations will be required at [redacted] and Headquarters in the future. 25X1

e. Amateur radio operators have traditionally provided candidates for Panel T. The elimination of the Morse requirement would allow recruiters to concentrate upon amateurs with exceptional technical skills rather than those who have developed Morse code proficiency.

4. A replacement for the present Morse system must be economically comparable with our present operations. Since the I/O devices for Morse are extremely low cost, a hand key and a pair of headphones, the cost trade off must take the form of people savings. A maximum estimate of people savings would entail reduction of four NCS operators at each of the four major overseas base stations for a sixteen operator reduction or an approximate $512,000 per year savings in cover reimbursement costs. This estimate does not include efficiency and perhaps cost savings at [redacted] It could be reasonably estimated that a minimum of eight operators could be reduced [redacted] justifies four operators for NCS guard) for a minimum saving of $256,000 per year. It would appear that a system with the features listed below would be cost effective: 25X1 25X1

a. The system design must allow for phased implementation. For instance, a conversion to two-way automatic Morse code would allow for some stations to operate in a manual mode while others are equipped with automated equipment. The present cadre of Morse operators would allow for a gradual conversion.

b. The system should allow for interoperability with other government agencies and services. We should retain the ability to work with Navy units during evacuation exercises, etc.

c. The system should be simple to operate. However, we can assume that field operators will be skilled in equipment operations and will be able to tune receivers for optimum reception.

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d. The system must be plug to plug compatible with existing HF equipment, e.g., HFL-1000, R-390, KWM-2, etc. The system designer may decide to pick off the receiver signal at the IF plug.

e. The system must be capable of sending and receiving a low volume of message traffic and operating signals or equivalents. There is no requirement for paper copy at field terminals. A ten character LED readout requiring pencil transcription would be sufficient. A keyboard similar to that used on electronic calculators would be adequate for field use due to the low transmission volume but a larger keyboard would be acceptable.

f. The system should be small in size and portable for off-station use and storage. Basically, the system should be no larger than a portable typewriter. Optimally the system should transmit and receive the 36 alphanumeric functions.

g. The system should operate from a 110/220 AC, 50/60 cycle source. Battery operation would be a desirable optional feature. (Particularly for [redacted] locations). 25X1

h. Field units should recognize code sequences and alarm with a local buzzer, bell or light. Relay closure upon code recognition for remote alarm activation is also desirable. At a minimum, field units should recognize and alarm upon a sequence assigned to that unit and upon a net call, e.g., [redacted] 25X1
The output device should display the alarm sequence received.

i. The base terminal must be capable of total automation in the future. The possibility of eventually remoting the NCS function to [redacted] should be a consideration. 25X1

j. The base terminal should provide paper readout for record purposes and utilize a communications type keyboard.

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k. The base terminal should alarm upon receiving a call and automatically acknowledge receipt of the field call.

l. Field units should cost no more than $1,000 each.

m. Base systems should cost no more than $50,000 each.

5. There are a host of alternatives to our present Morse network. Some of the more promising are discussed below and compared in chart form in Attachment D.

a. We could retain the present Morse network but lower our code speed requirements from 18 to 5 words per minute. The lower code speed would meet our present requirement adequately and would reduce training requirements. The change would not add any new costs to the network, or for that matter provide any efficiency gains. Hiring practices could be moderately liberalized.

b. We could retain Morse but change from international Morse code to an alternate code such as European Cut Numbers (ECN). Such a change would require extensive operational changes, e.g., call signs and operating signals would have to be converted to numbers, but the full capability to pass staff network signals and exchange a moderate amount of encyphered traffic would remain. An inexpensive device could be built to send cut numbers, e.g., a scratch keyer. Training time would be reduced to one week. Personnel with no previous Morse code experience could be hired for Panel T. The approach would not allow for inter-agency contact since we would be using a unique system.

c. We could substitute SSB voice for our present Morse network. This change would result in reduced signal gain. (See Attachment E). Procedural changes could be implemented to overcome this degradation. For instance, if every field station maintained a single

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receiver speaker guard on an appropriate frequency the chances of establishing contact with a station which could relay operating signals or messages when necessary would be excellent. The dispersed SSB guard concept would also fit well into any mini-relay scheme for staff altroute. Funds would be required for microphones and to adapt staff exciters, SG-75, for SSB voice operation. The KWM2A equipment would serve well as an off-station package for some time. This approach is in line with procedures used by other agencies and would allow for mutual support arrangements. Training time would be considerably reduced and hiring practices liberalized.

d. We could automate Morse code. Present technology will allow for the automatic generation of Morse code and micro-processor technology could be employed to read machine-generated Morse code. Two-way automated Morse would allow for well defined signals for conversion and allow for a start-up sequence to indicate signal presence. Standardized transmission rates, i.e., 9.5 wpm, would also provide a recognition key. This approach would retain the benefits of Morse, i.e., signal reliability, ability to fall back to manual operations, while eliminating the need for a fully trained Panel T cadre. Base station NCS operations could be automated with a resultant gain in efficiency and reduction in base station personnel requirements. The system should be designed for low speed operations, e.g., ten wpm, to allow for mixed manual/automatic operation during the conversion period. Adaptability to higher speeds at a later time would be a worthwhile feature. It would be useful if the base system could copy a limited manual Morse sequence for alert purposes, e.g., the base call sign or [redacted] sent at approximately 10 wpm. 25X1

e. We could change modes completely for the Morse (alternate) network. A tone signaling network similar to the English Piccolo system has been suggested. The field terminal would consist of a touch tone type pad which would be plug to plug compatible with

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present receivers, transmitters and transceivers. The 12 touchtone functions would adequately serve our signaling and message transmission needs. (Receiver stability could be a problem with the KWM2A.)

f. FSK could also be used. Use of this mode would allow for sharing of technology developed for covert application and for use of staff terminal equipment. Inter-operability with other agencies could suffer from this approach and conversion would be complicated.

g. A straight signaling system such as the RT-519 could be used with some modification. This type system would meet our primary needs, alert and signal exchange and could be modified for message exchange. Such a system would allow for increased reliability by redundant signal transmission. Inter-operability would suffer.

6. Our cost target should be $512,000 for a total program consisting of [redacted] field terminals, two per station, and [redacted] base systems. A five year conversion program would adequately meet our needs and allow for an almost immediate modification of hiring practices. [redacted] OC would, in all probability, be supportive of either effort since their operations into our base stations would be facilitated.

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ATTACHMENTS:
As Stated

ATTACHMENT A

MORSE USAGE

The following data was derived from [redacted] NCS logs for January, June and October 1976. The figures listed indicate a monthly average. 25X1

Average individual Field to Base Morse contacts per month:	16
Average characters sent during Morse contact (includes call sign):	18

25X1 Number of times most used operating signals appear in [redacted] logs per month. (Obviously most signals are used to bring attention to the on-line circuit.)

QSO	(Used to refer to HF RTTY or SKYLINK contact.)	29
QRK	(Readability)	28
ZTA 3	(Lease line)	21
QRV	(I am ready)	16
ZBO	(I have a message.)	12
QSA	(Signal strength.)	12
ZUG	(Negative-Normally coupled with QSO or QRK.)	11
ZUI	("Your attention is invited to." Normally relates to on-line circuit.)	11
ZTH 6	(Used for SELCAL tests.)	10

Other less frequently used signals are:

QJK 1	(You are on mark.)
QRU	(No traffic.)
QSX	(I am listening to _____.)

Other less frequently used signals continued:

ZAC (I am closing.)

ZUH (Unable to comply.)

QSW (Listen to _____.)

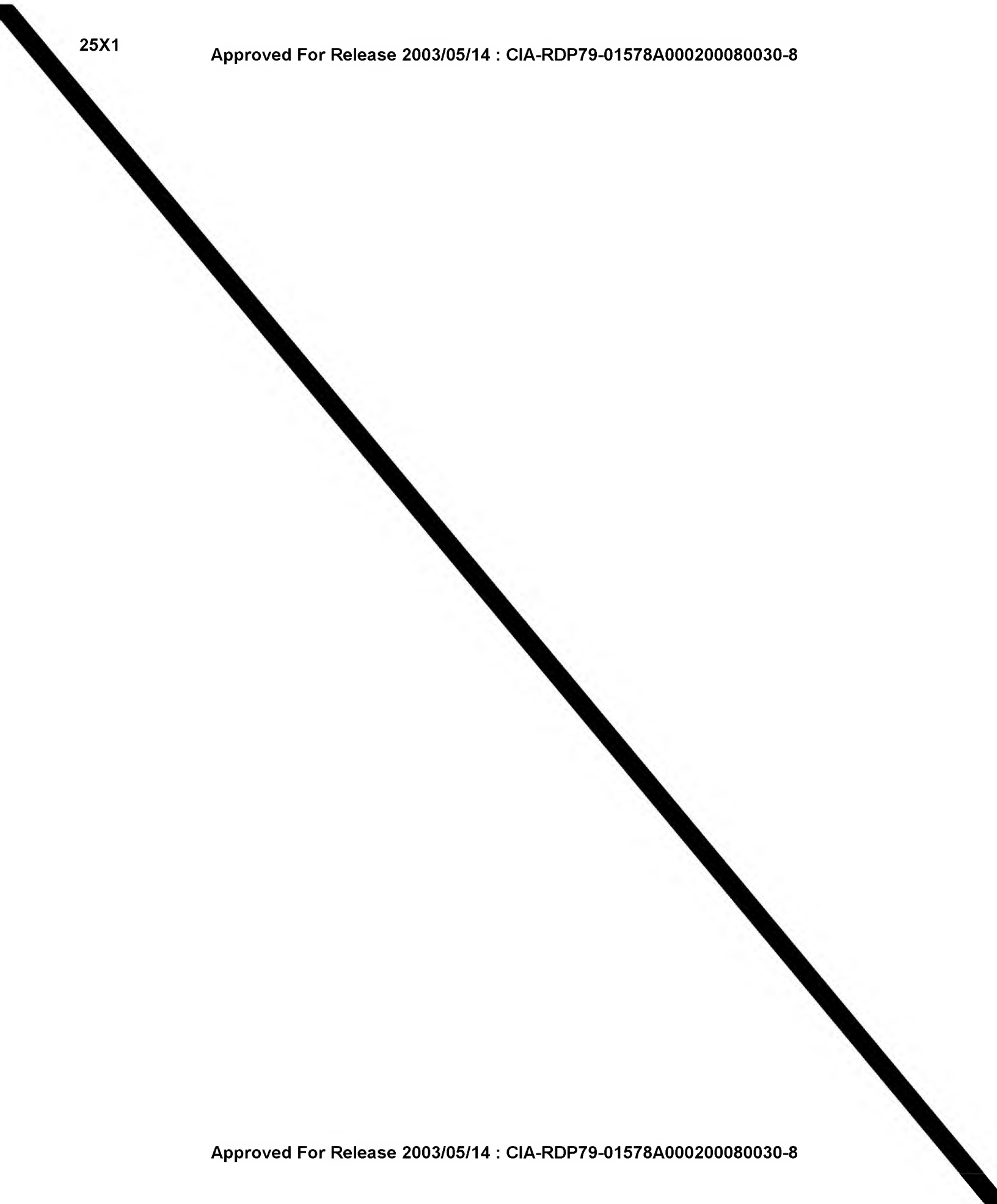
QRT (Stop sending.)

ZRF (Rephase)

ZHQ (Meet me on following frequencies.)

ZUJ (Standby)

HC2, BI low, EI, EJ (Deals with crypto phase.)



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3. WCS CW Requirements:

A. Receive 16 wpm European Cut Numbers
B. Receive 18 wpm Literal Text
C. Receive 16 wpm Long numbers
D. Send 16 wpm on Hand and Speed Key.
E. Total Morse Training Time: 20 hours

ATTACHMENT C

BASE STATION PANEL T REQUIREMENTS

1. Several individuals with base station management experience were asked to identify the skills that they would recommend for a Panel T employee assigned to a major base station. The following is a composite of their recommendations:

a. Be trained for todays base station operating, e.g., a complex facilities control, etc.

b. Be familiar with all cryptographic equipment in the OC inventory.

c. Have message switch experience.

d. Have good Morse code capability.

e. Have satellite operations experience.

f. Have some background in data systems.

g. Understand data transmission techniques.

h. Understand and be able to use test equipment, e.g., four channel scopes, BER test sets, audio test sets, etc.

2. A trend towards specialization is foreseen. 25X1 [redacted] uses the following rotation schedule in order to allow for full training and maximum utility of their operator cadre:

a.	MAX	9 Months
b.	SKYLINK	9 Months
c.	FACON	6 Months
d.	Special Ops	6 Months
e.	Transmitter Site	4 Months
f.	Crypto Control	4 Months

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